Retrofit Particulate Filter Demonstration on a Stationary Diesel Engine

Serpil Guran Ph.D.
New Jersey
Department of Environmental Protection

Air Innovations Conference, Chicago, 23-26 August, 2005

What is Fine Particulate Matter?

- Fine particulate matter, $PM_{2.5}$, is a mixture of fine liquid or solid particles such as dust, smoke, mist fumes or smog

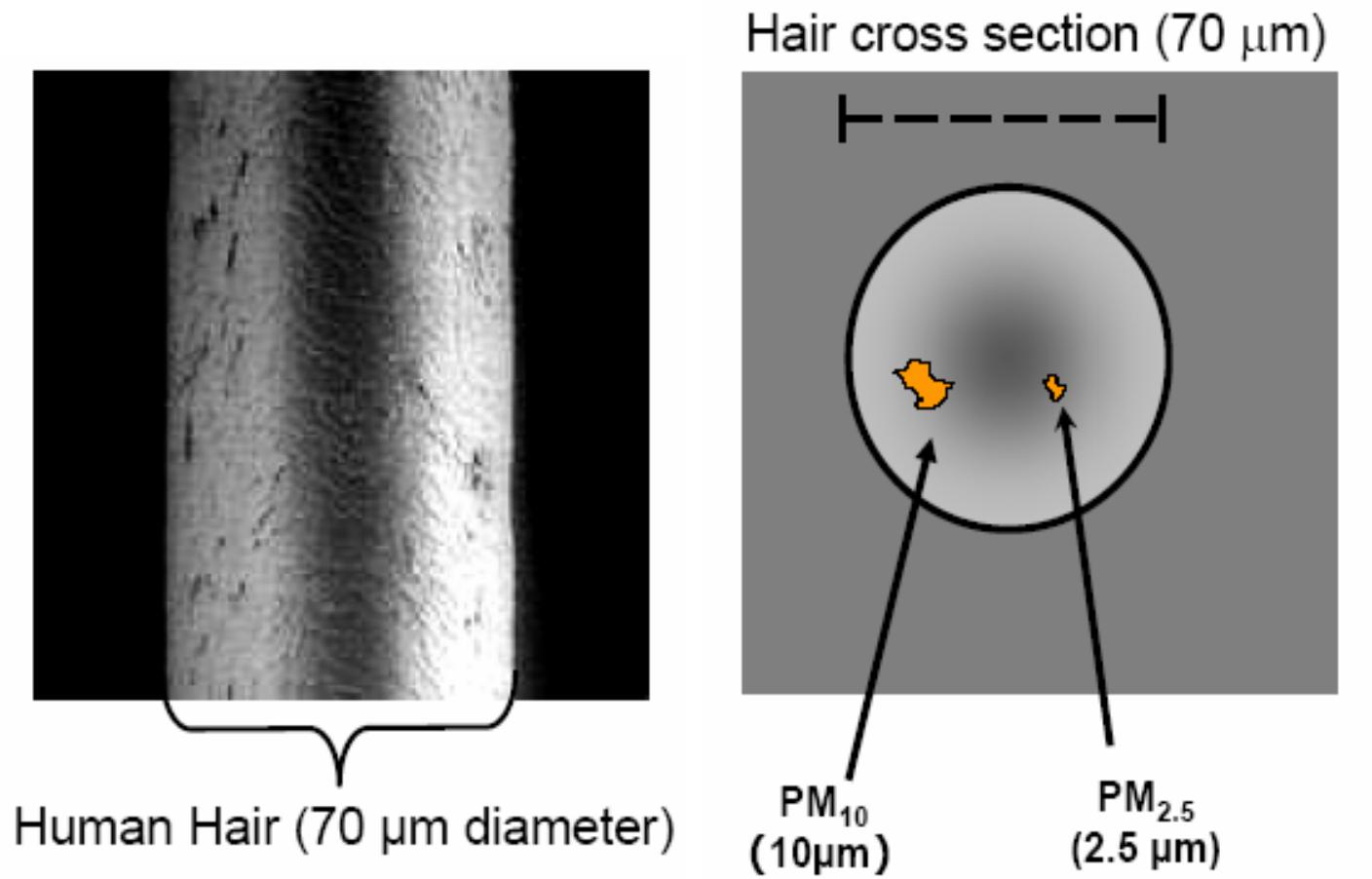
- Several thousand particles could fit on the period at the end of this sentence.

- Larger particles (> PM_{10}) deposit in the upper respiratory tract - the smaller, inhalable particles (≤ PM_{10}) penetrate into the lungs ($PM_{2.5}$ more so than $PM_{10-2.5}$)

Fine Particulates: $PM_{2.5}$

- Trucks, buses and off-road equipment
- New Jersey's Direction:
  - Reduce diesel smoke with stronger diesel smoke inspection
  - Retrofit the dirty engines
  - Prohibits vehicles such as buses (school, charter, public transportation), trucks (long haul, delivery) idling and queuing more than 3 minutes

Fine Particulate Matter: What is it?



M. Lipsett, California Office of Environmental Health Hazard Assessment

Detrimental Fine Particulate Health Effects

- Premature death
- Respiratory related hospital admissions and emergency room visits
- Aggravated asthma
- Coughing and difficulty or pain breathing
- Chronic bronchitis
- Decreased lung function
- Work and school absences

Achieving the fine particulate standard should save as many as

- **Premature deaths**

  - as many as 1,900 per year

- **Asthma attacks**

  - 53,000 per year

The Visibility and Haze Connection to Fine Particulate Emissions

- Visibility impairment is one of the most obvious effects of fine particles. It occurs at many natural parks and wilderness areas (also known as Class 1 areas)

- NJ has a protected Class 1 area located in Atlantic County - The Brigantine Wilderness Area of the Edwin B. Forsythe National Wildlife Refuge

Need for this Project:

- USEPA to propose $PM_{2.5}$ rule in 6 weeks and to be adopted next year.

Argus Air Daily

July 29,2005

Stationary Diesel Filter Project Participants:

- Stevens Institute of Technology
  - **Professor Richard B. Cole**
  - **Research Professor David Dietz**
- New Jersey Department of Environmental Protection
  - **Dr. Serpil Guran**
- Grenadier Realty Corp. Agent for Summit Plaza
- Engelhard Corporation
  - **Stan Mack, Diesel Filter Product Manager**

Host Site: 2.5 MW Power and Building Heat Energy Center, Summit Plaza, Jersey City

- One block area:
  - 3 High and 1 low rise apartment buildings (700 apartments and ~2,000 people)
  - A grammar school
  - Large commercial building
  - Social security offices
  - Shops and parking garage
  - 2900 kWh/day power consumed

Summit Plaza: Jersey City, NJ

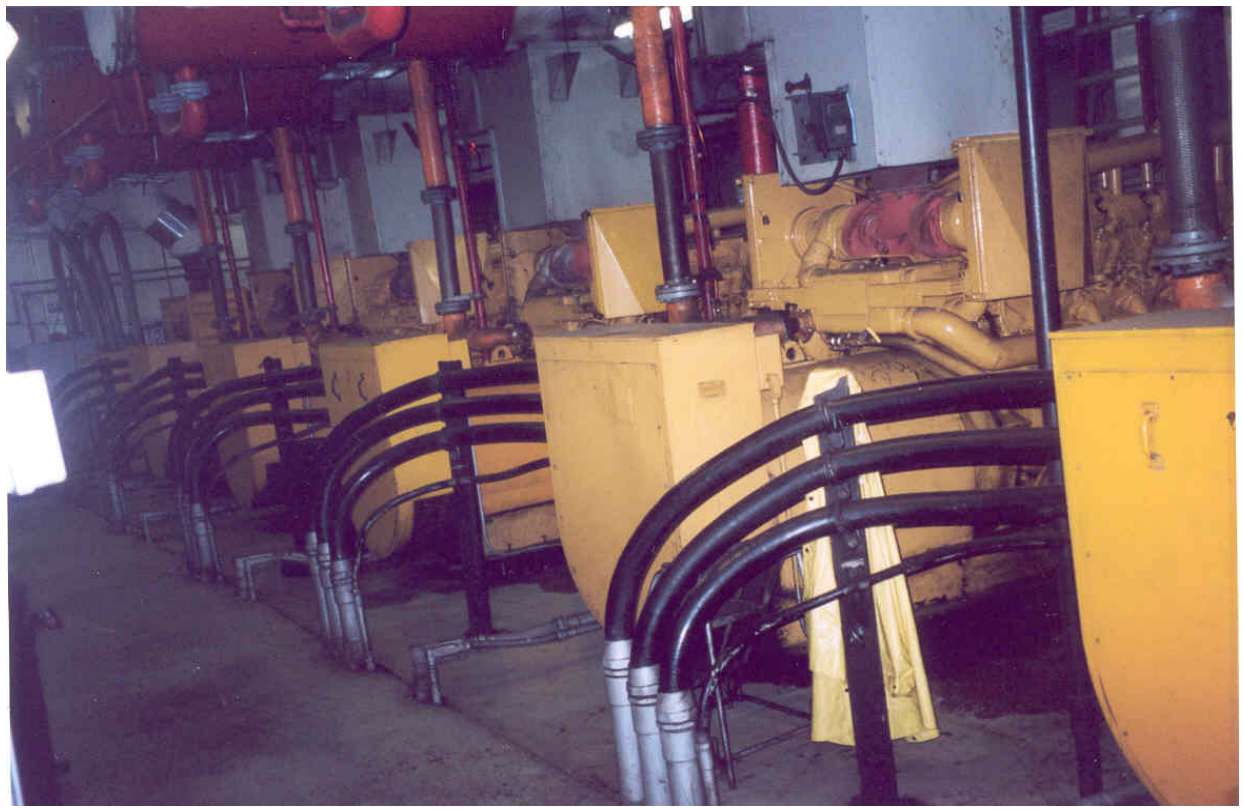
Summit Plaza


CONSTANCE P. NICHOLS SCHOOL
P.S. 42

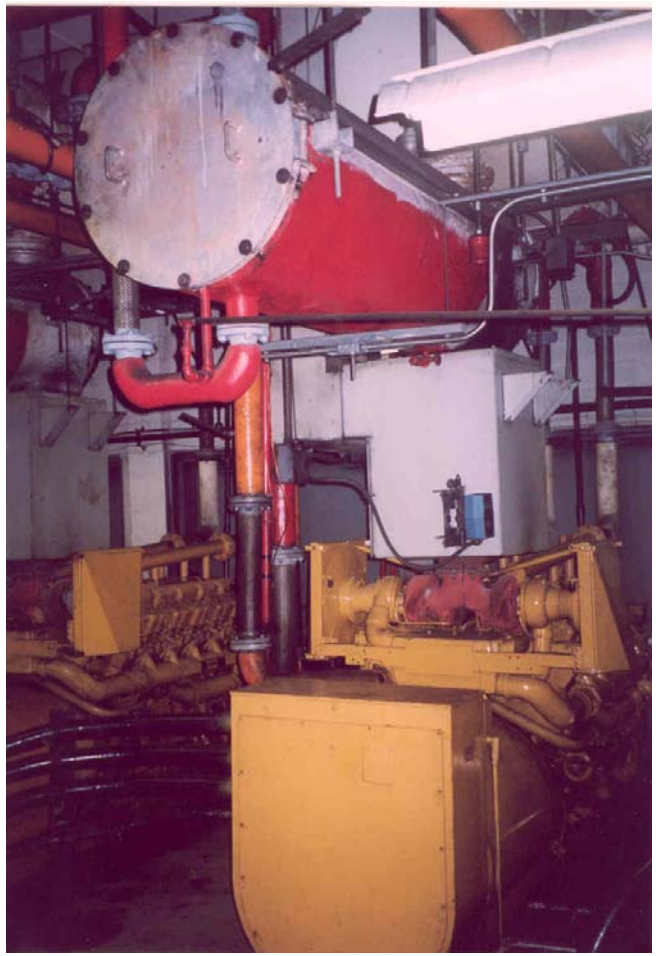
Summit Plaza, Jersey City
Total Energy Plant

- Co-generation facility supplies heat (hot water heat) and air conditioning (chilled water cooling)
- Central garbage vacuum system (150kW)
- 2,000 gallons diesel/per day (3 engines always running with 99.8% reliability by using back-up engines on a rotation basis)

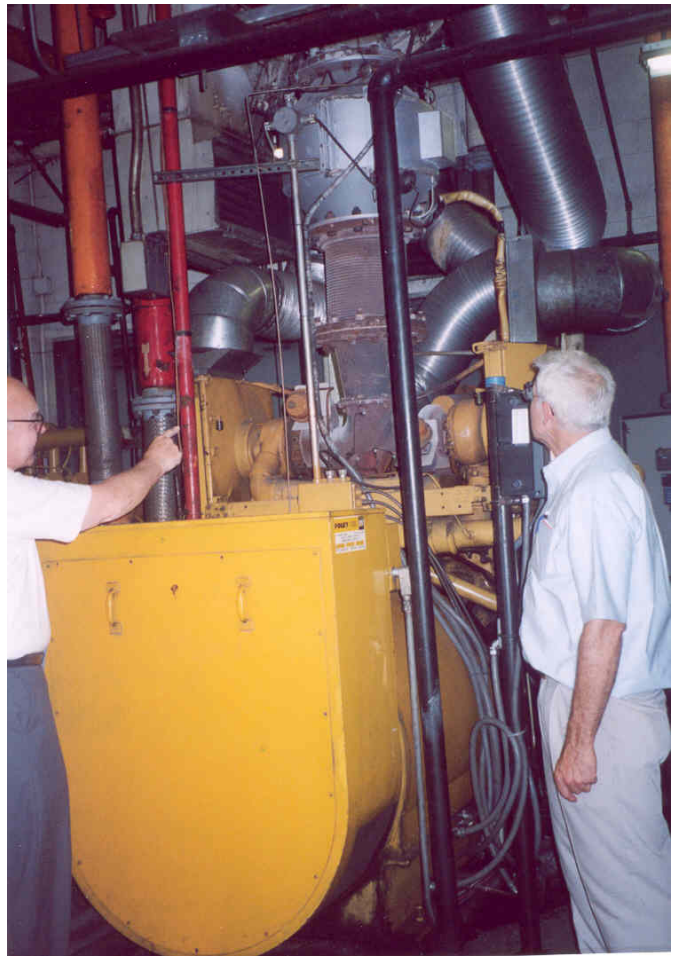
Five- 500 kW Electric Diesel Generators



Engine Exhaust Heat Recovery for Heating and Air Conditioning



Retrofit Particulate Filter Location



New Jersey 2002 Diesel Point Sources

Pollutant	Tons Per year	# of Engines
NOx	684	778
SO_2	146	429
VOC	36	486
CO	183	683
PM10	52	395
PM2.5	53	414

Source: USEPA

Program Expectations:

- With this retrofitting technology:

  PM, CO and HC should be reduced 60 %

- If this technology is applied to all sources in New Jersey estimated benefits:
  - **31.2 tons PM_{10} per year**
  - **32 tons $PM_{2.5}$ per year**
  - **109 tons CO per year**

Jersey City Area (Hudson County) Toxics Emissions

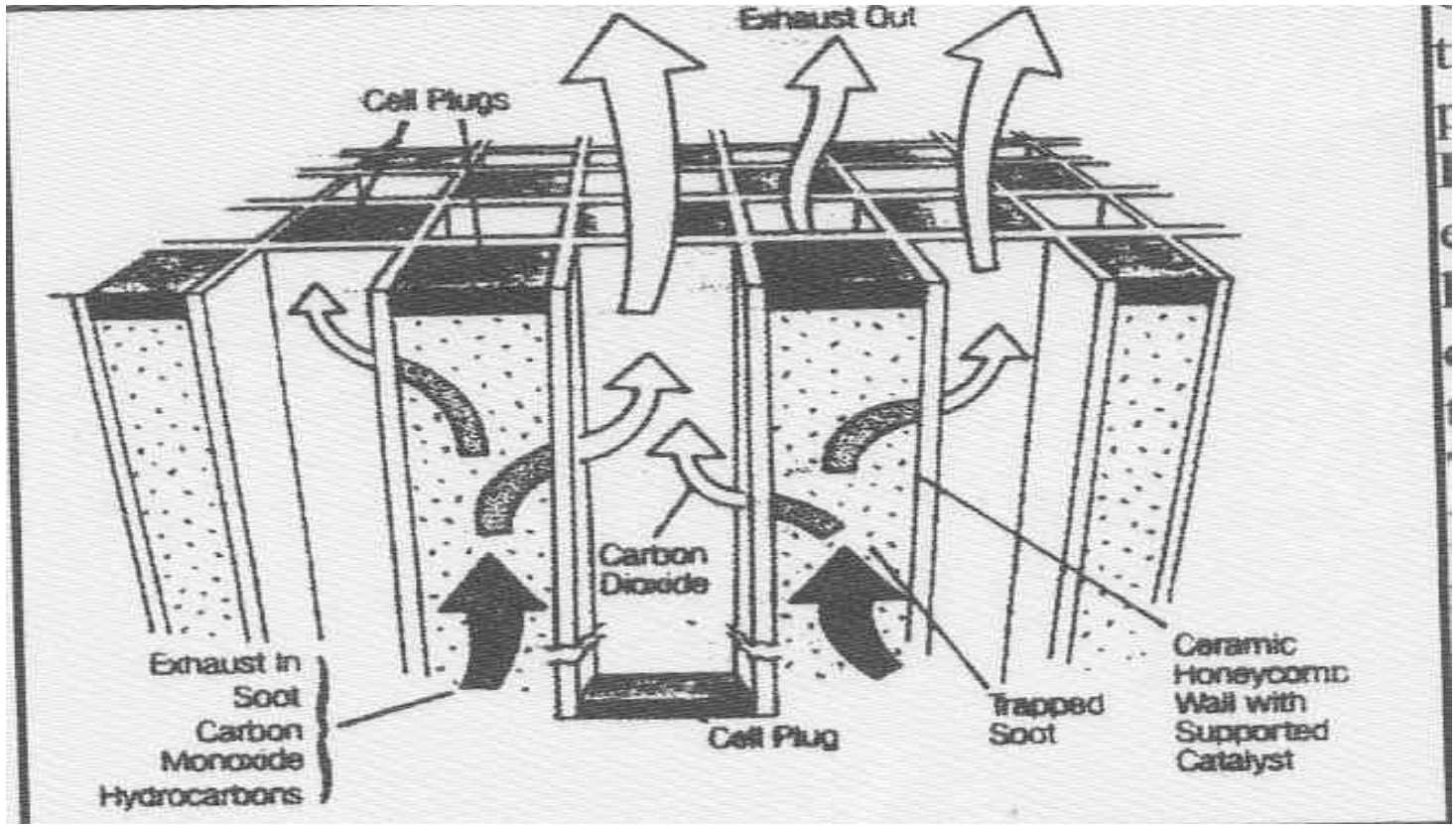
Toxic	NJ Statewide tpy	Hudson County NJ, tpy
Acetaldehyde	10	1.2E-03
Arsenic Compounds	0.2	1.9E-05
Benzene	33	4.0E-03
Beryllium Compounds	0.1	1.4E-05
Cadmium Compounds	0.1	1.4E-05
Chromium Compounds	0.1	1.4E-05
Formaldehyde	4.0	4.7E-04
Lead Compounds	0.3	4.2E-05
Manganese Compounds	0.2	2.8E-05
Mercury Compounds	0.1	1.4E-05
Polycyclic Organic Matter (PAH)	15	1.9E-03

Source: USEPA NATA Inventory

Retrofit Technology: DPX™ Particulate Filters (Engelhard Corp, Edison, New Jersey)

- USEPA verified mobile diesel emission reduction technology
- Widely used for light and heavy duty engine use on mobile sources
- Ceramic honey comb with hundreds of parallel channels coated with precious metal catalyst coating
- Emission reductions: PM, HC & CO

DPX Particulate Filter



Comparison of Stationary vs. Mobile DPX™ Issues

Application	Mobile	Stationary
Operation	Transient with a wider operating window	Steady State with a few design cases
Design Issues	Space and packaging constraints	Custom designs with site specific requirements
Warranty	Heavy Duty-450,000 miles or about 10,000 hrs	2 to 3 yr. at 4000 to 8000 hrs/yr
Vibration	Very High	High
Design Approach	Optimized for Platform	Conservative to overcome inaccurate/incomplete information
Measurement	Verification in test cells under controlled conditions	Require field methods in less controlled conditions

Project Schedule:

- First three month:
  - Planning the approach to estimating the reduction of stationary source diesel emissions using filter technology
  - Design, procure and install the filter control device
- Six month demonstration period:
  - Demonstration of the DPX™ particulate filter
  - Developing an inventory of diesel engines in New Jersey with the associated yearly emission estimates
- Last three month:
  - Determining the applicability of diesel particulate filters with respect to the New Jersey Inventory of stationary sources in reducing stationary diesel emissions
  - Report the applicability of the filter as a retrofit for stationary diesel engines

EPA Program Benefit to the State of New Jersey

- Will show that emission control technologies can be employed in areas that are prone to particulate health risks

- Aid future state planning to reduce NJ's particulate emissions

Thank you,
Serpil.guran@dep.ststate.nj.us
(609) 341-3124